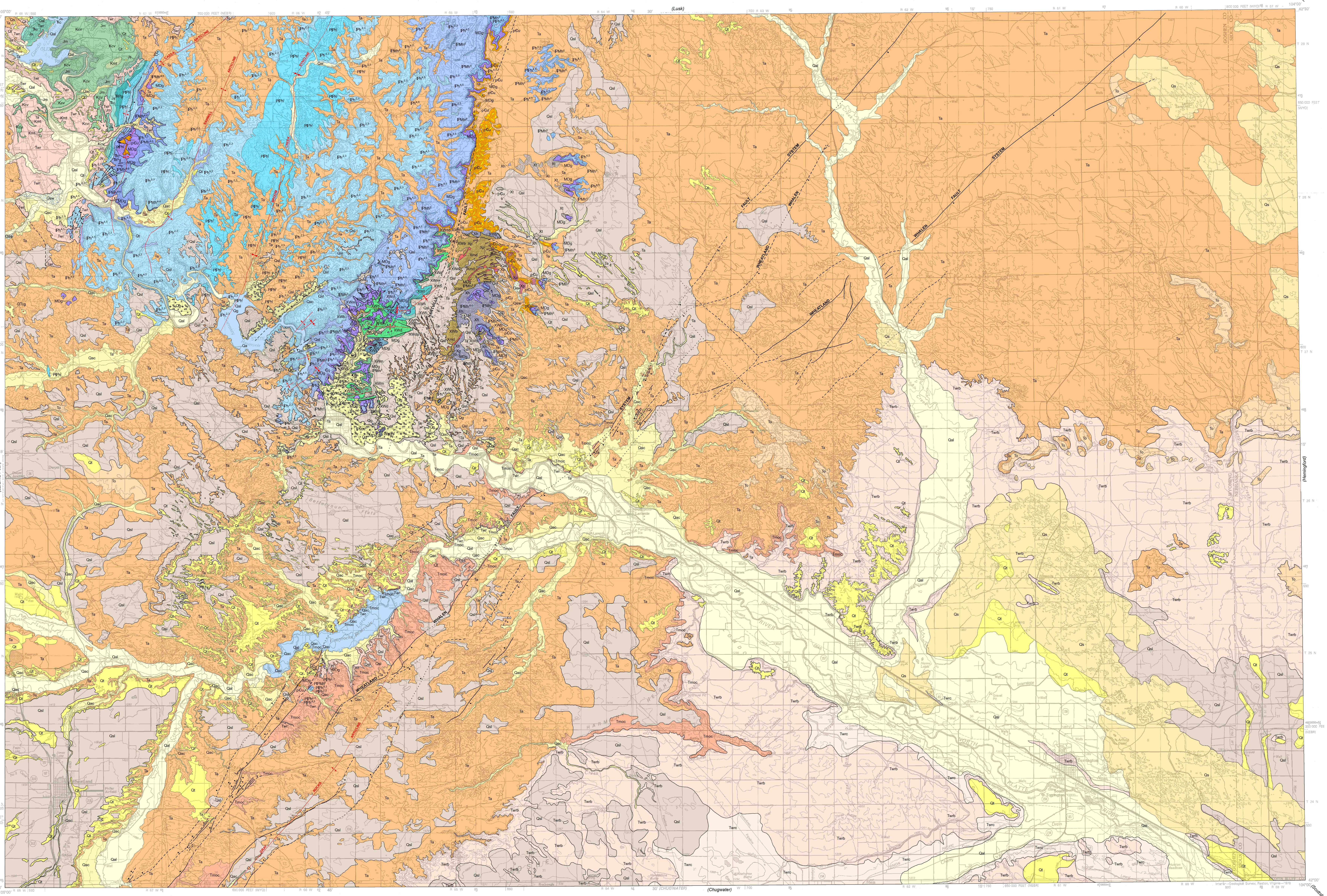
WYOMING STATE GEOLOGICAL SURVEY
Ronald C. Surdam, State Geologist
Laramie, Wyoming

Geology - Interpreting the past to provide for the future

Prepared in cooperation with the U.S. GEOLOGICAL SURVEY

MAP SERIES 66
Torrington 1:100,000 - scale
Preliminary Geologic Map



Base map from U.S. Geological Survey 1:100,000 - scale metric topographic map of the Torrington, Wyoming - Nebraska 30 x 60 minute Quadrangle, 1978

Projection: Universal Transverse Mercator (UTM), zone 13
North American Datum of 1927 (NAD 27)
10,000-meter grid ticks: UTM, zone 12
50,000-foot grid ticks: Wyoming State Plane Coordinate System, east zone and Nebraska north zone

UTM GRID CONVERGENCE (GN) 1978 MAGNETIC DECLINATION (MN) AT CENTER OF SHEET
DIAGRAM IS APPROXIMATE

SCALE 1:100,000
CONTOUR INTERVAL 20 meters

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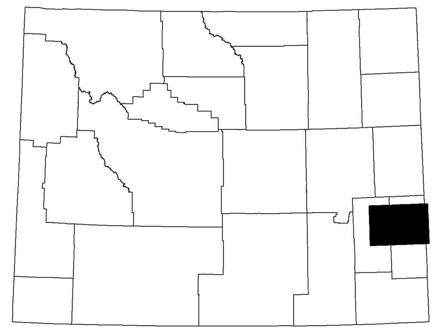
Digital cartography by J. Fred McLaughlin, Justin M. Mulbay, Robin W. Lyons, Alice J. Vogelmann, Phyllis A. Ranz, and David W. Lucke

Map design and editing by Richard W. Jones

GEOLOGIC MAP OF THE TORRINGTON 30' x 60' QUADRANGLE, GOSHEN AND PLATTE COUNTIES, WYOMING, AND SIOUX AND SCOTTS BLUFF COUNTIES, NEBRASKA

compiled and mapped by
J. Fred McLaughlin and Ray E. Harris
2005



WYOMING QUADRANGLE LOCATION

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6. Love, J.D., Denson, N.M., and Botinelly, T., 1949, Geology of the Glendo area: U.S. Geological Survey Oil and Gas Investigations Preliminary Map 92, sheet 1, scale 1:48,000.

7. McGrew, L.W., 1963, Geology of the Fort Laramie area, Platte and Goshen Counties, Wyoming: U.S. Geological Survey Bulletin 1141-F, 39 p., plate 1., scale 1:31,680.

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McLaughlin, J.F., and Harris, R.E., 2004, Preliminary geologic map of the Torrington 30' x 60' Quadrangle, Goshen and Platte Counties, Wyoming, and western Nebraska: Wyoming State Geological Survey Open File Report 04-11 scale 1:100,000.

14. McLaughlin, J.F., and Stafford, J.E., 2008, Preliminary geologic map of the Lusk 30' x 60' Quadrangle, Goshen and Niobrara Counties, Wyoming: Wyoming State Geological Survey Open File Report 08-5, scale 1:100,000, 1 sheet, color.

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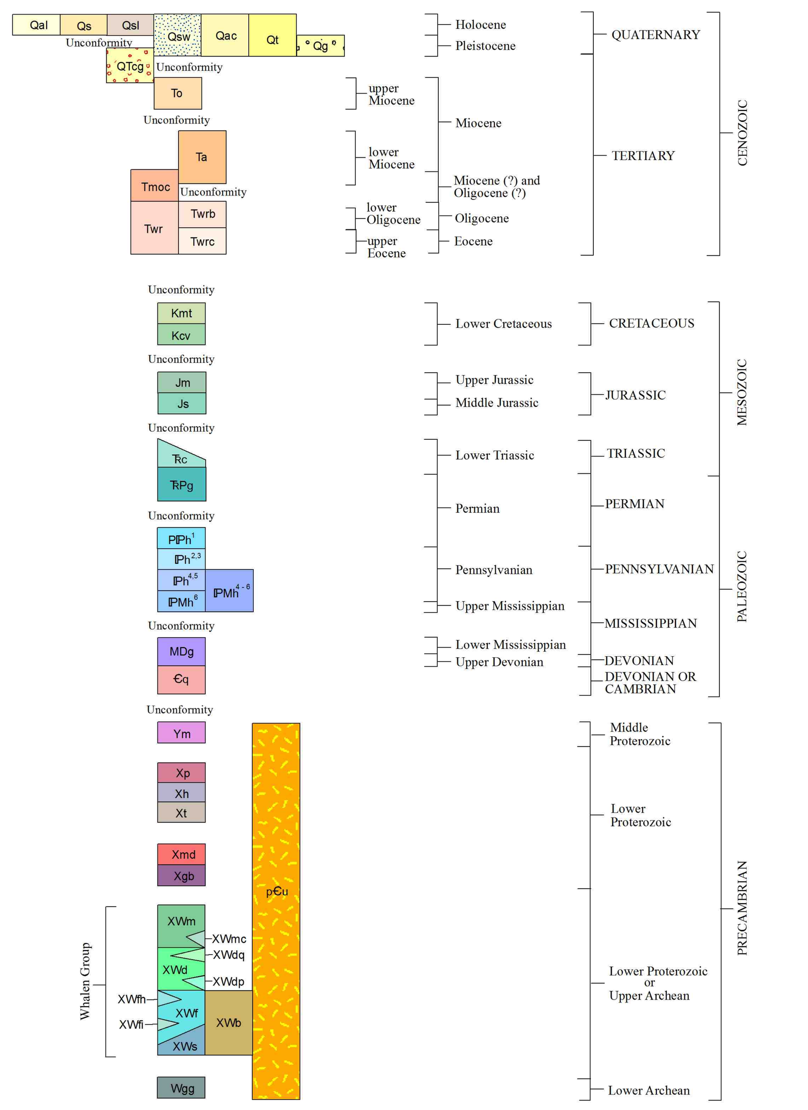
CORRELATION OF MAP UNITS



MAP SYMBOLS

Formation contact

Fault—Bar and ball on downthrown block; dashed where approximately located and dotted where concealed

Anticline—Trace of axial plane and direction of plunge compiled from source mapping or by field dip measurements

Syncline—Trace of axial plane and direction of plunge compiled from source mapping or by field dip measurements

Ym—Metadiabase (Middle Proterozoic)

Xmd—Metadiabase dikes (Lower Proterozoic)

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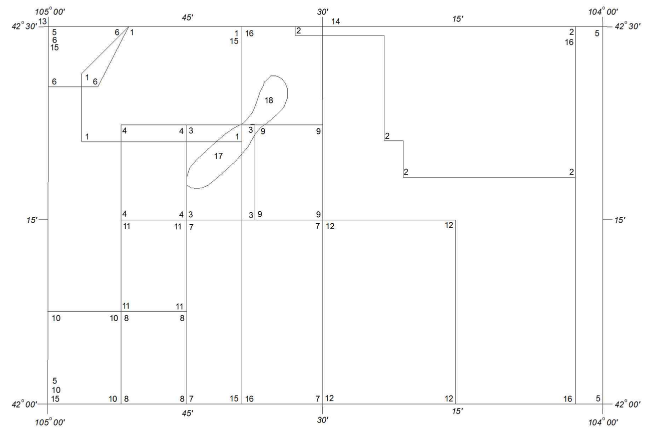

INDEX TO GEOLOGIC MAPPING
(numbers are those listed in REFERENCES CITED AND SOURCES OF GEOLOGIC DATA)

E X P L A N A T I O N

DESCRIPTION OF MAP UNITS

Quaternary surficial deposits

Qal **Alluvial deposits (Holocene)**—Silt, fine-grained sand, and some gravel as valley fill in the present flood plains, bars, and islands of the principal streams; includes gravel, sand, silt, mud, and clay deposited in and around reservoirs. Variable thickness; may exceed 200 feet 61 m) in Platte River valley (Rapp and others, 1957)

Qs **Dune sand (Holocene)**—Fine-grained, windblown sand; variable thickness

Qsl **Sand and loess (Holocene)**—Fine-grained residual sand and loess; thickness from 0 to 40 feet (0 to 12 m)

Qsw **Slope wash (Holocene and Pleistocene)**—Pebbles, cobbles, and gravels amidst a variegated matrix; the result of mass wasting on steep slopes. Includes angular blocks of Paleozoic and Precambrian rocks at the base of the steeper slopes in the Haystack Range

Qac **Mixed alluvium and colluvium (Holocene and Pleistocene)**—Unconsolidated to poorly consolidated clay, silt, sand and gravel; mostly in flood plains and low terraces. Thickness generally 0 to 50 feet (0 to 15 m)

Qt **Terrace gravels (Holocene and Pleistocene)**—Pebble, cobble, and boulder deposits containing some silt, fine-grained sand, lenses of bentonitic clay, and locally some ash beds; thickness 0 to greater than 210 feet (64 m) on the highest terrace levels (Rapp and others, 1957)

Qg **Gravel deposits (Pleistocene)**—Boulder to pebble conglomerate deposited in a fluvial environment by the ancestral North Platte River. Contains fluvial cross-bedded sand zones. The boulders include many types of crystalline, metamorphic, and sedimentary rocks including but not limited to granite, monzonite, amphibolite, schist, quartzite, marble, limestone, and sandstone. A fragment of black jade was found on the Guernsey Quadrangle (Harris and others, 2008a). Includes clasts from the Hartville uplift as well as clasts from the Laramie Mountains and farther west. Occurs as upland deposits in the Guernsey and Guernsey Reservoir areas (Harris and others, 2008a, 2008b) along the North Platte River. Thickness variable, but local thicknesses may exceed 150 feet (46 m) to as much as 225 feet (69 m) (Rapp and others, 1957)

Quaternary(?) and Tertiary(?) deposits

QTcg **Pleistocene(?) to Miocene(?) conglomerate**—Giant boulders, as large as 16 feet (5 m) in diameter, of granite in a brown arkosic matrix, overlapping lower Miocene sandstones in T. 27 N., R. 68 W., and to the west. Present only on high interstream divide extending east from Laramie Mountains. Age uncertain. Some slope wash deposits (Qsw) north of Guernsey that contain angular clasts of Paleozoic and Precambrian rocks may be equivalent in part to these deposits. Thickness 0 to 100 feet (0 to 30 m)

Tertiary sedimentary rocks

To **Ogallala Formation (upper Miocene)**—Fine- to coarse-grained, light-gray to greenish-, yellowish-, and orange-gray sandstone interbedded and interfingered in upper part with conglomerate, claystone, and freshwater limestone; white to dark-gray vitric tuff beds near top; lower part has hard "pipy" calcareous sandstone concretions. Thickness 0 to 400 feet (0 to 120 m)

Ta **Arikaree Formation (lower Miocene/Oligocene)**—Light-gray to buff, fine-grained poorly bedded sandstone containing abundant magnetite grains; some siltstone, limestone, and tuff; lenticular conglomerate near base; thickness 0 to 705 feet (0 to 215 m

Tmoc **Miocene(?) and Oligocene(?) conglomerate**—Mostly light-gray conglomerate and gray channel sandstone interbedded with blocky brown and gray claystone and orange-gray siltstone. Claystone is like that in underlying White River Formation (Twr). Clasts in conglomerate are Paleozoic and Precambrian rocks, mostly in a gray calcareous sandstone matrix. In southwestern part of quadrangle is a red conglomerate facies composed of red to light-red poorly cemented conglomerate chiefly of pebbles, cobbles, and boulders derived from Paleozoic and Precambrian rocks in an orange-red claystone and siltstone matrix locally derived from red beds (McGrew, 1963; McGrew and Sever, 1978). Thickness 0 to 490 feet (0 to 150 m)

Twr **White River Group (Oligocene and upper Eocene)**—White to pale-pink, blocky, tuffaceous, bentonitic claystone and lenticular arkosic conglomerate with lenses of thin gray sandstone; thickness 0 to 1,150 feet (0 to 351 m). Subdivided into an upper unit (Brule Formation) and a lower unit (Chadron Formation) in eastern two-thirds of quadrangle. $^{40}Ar/^{39}Ar$ age date of ash layer at top of Chadron Formation in south-central Wyoming is approximately 34 Ma (mega-annum or millions of years before present), now defined as the Eocene-Oligocene boundary in North America (Prothero and Swisher, 1992; Lillegraven, 1993), so the Chadron is considered latest Eocene in age and at least the lower part of the Brule earliest Oligocene in age

Twrb **Brule Formation (Oligocene)**—Pale-pink to white argillaceous siltstone with local channel sandstone, limestone, claystone, and volcanic ash; thickness 0 to 450 feet (0 to 137 m)

Twrc **Chadron Formation (upper Eocene)**—Variegated tuffaceous and bentonitic claystone and siltstone, with channel sandstone and conglomerate; lower part contains fluvial deposits; thickness 0 to 700 feet (0 to 213 m).

Mesozoic sedimentary rocks

Kmt **Muddy Sandstone and Thermopolis Shale undivided (Lower Cretaceous)**—Muddy Sandstone at top is a gray, medium-grained, clean sandstone with high concentration of quartz, interbedded with gray to black shale and bentonite; thickness 50 to 100 feet (15 to 30 m). The underlying Thermopolis Shale is black, very fine grained, fissile, flaky, soft shale with many thin, cream-colored bentonite partings, thin ferruginous sandstone, and ironstone laminae; thickness 100 to 160 feet (30 to 49 m)

Kcv **Cloverly Formation (Lower Cretaceous)**—Chiefly sandstone, subdivided into three units: an upper sandstone, a middle shale unit, and a basal sandstone. The upper sandstone is is gray, medium-grained noncalcareous; somewhat more shaly, more ferringous, and thinner-bedded than the basal sandstone; contains numerous burrows and worm holes. Thin middle shale unit is mostly gray, but in a few places black or pale pink, very soft, plastic and waxy, and in places interbedded with sandstone and siltstone. Basal sandstone consists of thin, gray, sparkly, medium-grained noncalcareous sandstone that weathers buff; commonly 50 to 75 feet (15 to 23 m) thick. It is often very hard to tell the upper sandstone from the basal sandstone due to their homogeny. Total thickness 175 to 320 feet (53 to 98 m)

Jm **Morrison Formation (Upper Jurassic)**—Dull, variegated, bentonitic claystone, fine-grained fresh-water limestone, with layers, beds, and lenses of tan to gray sandstone. Limestone beds containing cherty algal beds are present near the top, and numerous thin beds of gray, fine-grained, poorly bedded, clayey fresh-water limestone occur in the lower part of the formation. Claystone is dull green, dull pink, and purple, and is hard and siliceous. The top of the Morrison is marked by a sharp lithologic break and an erosional unconformity. The base is placed at the bottom of a yellowish-buff sandstone, where a conspicuous erosional break occurs with the underlying Sundance Formation. Thickness 130 to 220 feet 40 to 67 m)

Js **Sundance Formation (Middle and Upper Jurassic)**—Divided into two informal units. The upper Sundance consists of glauconitic green shale and shaly sandstone, with a gray, glauconitic, basal sandstone up to 30 feet (9 m) thick; thickness of upper unit is 50 to 120 feet (15 to 37 m). The lower Sundance is fine-grained, non-glauconitic, limy sandstone, commonly red near the top, with persistent shaly and silty zones near the base; shale zones are purple, green, and gray; siltstone zones are olive drab; thickness of lower unit is 140 to 220 feet (43 to 67 m). Total thickness of Sundance is 190 to 340 feet (58 to 104 m)

TRc **Chugwater Formation (Lower Triassic)**—Red shale and siltstone with some red sandstone and shale, and in the lower part gypsum laminae along with some anhydrite; upper part is more limey than the lower part and a major unconformity exists at the top of the formation; thickness 150 to 435 feet (46 to 133 m)

Mesozoic and Paleozoic sedimentary rocks

TRPg **Goose Egg Formation (Lower Triassic and Permian)**—Interbedded red to ocher shale and siltstone, thin limestone, limestone breccias, and gypsum beds; thickness 195 to 345 feet (59 to 105 m)

Paleozoic sedimentary rocks

Hartville Formation—Subdivided into six informal divisions, numbered from 1 (stratigraphically highest) to 6 (stratigraphically lowest). Some divisions are combined for ease in mapping

Pℙh^{1} **Division 1 (Permian and Pennsylvanian)**—Red, silty shale and siltstone, red eolian sandstone, and limestone; forms ledges and slopes; thickness 0 to 300 feet (0 to 91 m)

ℙh^{2,3} **Divisions 2 and 3 (Pennsylvanian)**—Interbedded gray limestone; buff to chalky white limestone and dolomite; pink dolomite; buff eolian sandstone; gray, red, and maroon siltstone and claystone; and thin black shale. Brachiopods are common in the limestone and dolomite layers; forms ledged slopes and cliffs; thickness 0 to 300 feet (0 to 91 m)

ℙh^{4,5} **Divisions 4 and 5 (Pennsylvanian)**—Interbedded maroon, pink, and gray siltstone and claystone; gray, brown, and buff limestone; pink dolomite; and thin gray sandstone beds. Forms smooth slopes with limestone ledges; thickness 0 to 250 feet (0 to 76 m)

ℙMh^{6} **Division 6 (Pennsylvanian and Upper Mississippian)**—Well-indurated maroon to red orthoquartzite that forms cliffs and rocky knolls. Deposited on a well-developed karst surface, and fills sinkholes and caverns in limestone of the underlying Guernsey Formation. Sporadically exposed and is absent in many areas within the quadrangle. This unit is equivalent to the Darwin Sandstone Member of the Hartville as described by Sando and Sandberg (1987). Thickness 0 to 120 feet (0 to 37 m)

ℙh$^{4-6}$ **Divisions 4, 5, and 6 undivided (Pennsylvanian and Upper Mississippian)**

MDg **Guernsey Formation (Lower Mississippian and Upper Devonian)**—Subdivided into an upper limestone unit of Early Mississippian age and a lower unit of Devonian age. The upper Guernsey consists of gray, cherty, coarsely crystalline, coarsely bedded, hard limestone; the chert has variety of colors and there are predominant dark-brown quartzitic layers and nodules in this unit; average thickness approximately 135 feet (41 m). The surface of the upper unit is highly irregular, with many local variations (marked by general thickening of formation toward the northwest). The lower unit is purple to gray dolomite, thin-bedded, slabby, fine-grained, hard, brittle, and silty, interbedded with hard, dolomitic purple shale and siltstone; thickness approximately 65 feet (20 m). Approximately 4 feet (1.2 m) of pink arkose with abundant feldspar and white quartz grains and pebbles occurs at base of lower unit and rests on Precambrian rocks. Total thickness exposed in the Hartville area is 140 to 260 feet (43 to 79 m). [Note: in places where this basal arkose and cross-bedded orthoquartzite occurs, it is mapped as Devonian or Cambrian quartzite (€q) as described below.]

The basal arkosic sandstone of the Guernsey was previously interpreted as Cambrian in age, but Sando and Sandberg (1987) reinterpreted this as the Fremont Canyon Sandstone (new name) and assigned it to the Upper Devonian. These authors considered the Guernsey Formation a superfluous name and divided it instead into the Madison Limestone (Mississippian in age) at the top, the Englewood Formation in the middle, and the Fremont Canyon Sandstone (Devonian in age) at the base.

€q **Quartzite (Devonian or Cambrian)**—Gray to red to cream-colored, coarse-grained, cross-bedded orthoquartzite found in lenses locally throughout the area. Possibly equivalent to the Deadwood Quartzite/Flathead Sandstone (Cambrian) or based on work by Sando and Sandberg (1987), the lowermost part of the Englewood Formation and the Fremont Canyon Sandstone

Precambrian metasedimentary and crystalline rocks—All descriptions except that for p€u were modified from Sims and others (1997)

p€u **Precambrian rocks undifferentiated (Lower Proterozoic to Upper Archean)**—Brown, coarse-grained weathered granite, quartzite, banded gneiss and schist, some metasedimentary and metaigneous rocks (may include banded iron formation, hematite bodies, and other lithologies of the Whalen Group), and gneissic granite cut by white quartz dikes and veins

Middle Proterozoic (1,600 to 900 Ma) rocks

Ym **Metadiabase**—Dark-green, medium-grained diabase dikes with marginal chill zones; intrudes the Haystack Range Granite (Xh). May be represented by a line of same color in areas where it is too thin to be shown as a polygon

Lower Proterozoic (2,500 to 1,600 Ma) rocks

Xp **Pegmatites related to Haystack Range Granite**—White to gray, coarse-grained, zoned to unzoned feldspar-quartz-muscovite-tourmaline granitic dikes; contains accessory biotite, garnet, and beryl. Most abundant on the north side of the Haystack granite dome. Estimated thickness 330 to 490 feet (100 to 150 m)

Xh **Haystack Range Granite**—Pink, coarse- to medium-grained, massive to foliated, inequigranular biotite granite and lesser fine-grained granite. Fine-grained phase grades into or forms dikes in the coarse-grained facies. Constitutes a granite dome in the Haystack Range. Rubidium-strontium (Rb-Sr) whole rock age of 1,720 Ma (Snyder and Peterman, 1982)

Xt **Twin Hills Diorite**—Dark-gray, medium-grained, homogeneous hornblende-biotite monzonite to mafic diorite locally containing clinopyroxene and orthoclase; locally cut by dikes of Haystack Range Granite (Xh); mapped only in T. 28 N., R. 64 W., in the Twin Hills and several miles to the south. Snyder and Peterman (1982) reported a uranium-lead (U-Pb) discordia intercept age date of 1,740 Ma for this unit

Xmd **Metadiabase dikes**—Dark, greenish-black, medium-grained hornblende-plagioclase-quartz metadiabase; granular amphibole east of the Hartville fault. Veins strike north-northwest except on the north side of the Haystack Range granite dome. May be represented by a line of same color in areas where it is too thin to be shown as a polygon. Age approximately 2,000 Ma (Snyder, 1993).

Xgb **Metagabbro**—Dark grayish-green, fine- to coarse-grained hornblende and chlorite containing metagabbro. Variable layering and foliations, foliations more distinct along border of unit

Lower Proterozoic or Upper Archean rocks (units of the Whalen Group)

XWm **Metabasalt**—Dark-green, fine-grained actinolite-biotite-chlorite schist; flows are locally pillowed. Estimated thickness 330 to 490 feet (100 to 150 m)

XWmc **Calc-silicate rock**—White to light-green pods that are 4 to 6 inches (10 to 15 cm) in diameter and form 30 to 50% of unit, containing actinolite, diopside, talc, and epidote

XWd **Metadolomite**—Gray, pink, white, and yellow, medium-grained dolomite and marble, tremolite dolomite, siliceous dolomite, and limestone. Tremolite occurs as radiating blades. Contains abundant stromatolites. Estimated thickness 980 to 1,100 feet (300 to 350 m)

XWdq **Quartzite**—Found near the stratigraphic top of Metadolomite (XWd) northwest of Guernsey (specifically the area north of the Chicago mine)

XWdp **Metapelite**—Thin, gray to brown plagioclase-quartz-biotite-muscovite schist; inter-preted as metapelite (metamorphic mudstone or shale). Occurs near the base of Metadolomite (XWd) along the Graves Ranch anticline

XWf **Ferruginous schist**—Includes biotite-chlorite schist, phyllite, and ferruginous quartzite

XWfh **Hematite deposits**—Hematite bodies associated with and found at the top of Ferruginous schist (XWf) unit. Mined for iron northwest of Guernsey at the Good Fortune (GF), Sunrise (S), and Chicago (C) mines; consists of specularite (a black or gray variety of hematite that has a highly intense luster) and associated colloform (rounded) hematite

XWfi **Banded iron formation**—Alternating bands of iron-rich minerals, generally hematite and chert

XWb **Quartzofeldpathic schist with graded bedding**—Schist containing garnet, sillimanite, and some andalusite and pyrite, commonly with graded bedding; found east of the Hartville fault

XWs **Quartzofeldpathic schist**—Gray, medium- to fine-grained chlorite- and garnet-bearing schist; located west of the Hartville fault; estimated thickness 3,300 feet (1,000 m)

Lower Archean (3,000 to 2,500 Ma) rocks

Wgg **Granite gneiss**—Pink, mylonitic granite gneiss; presumed correlative with granite of Rawhide Buttes (Snyder, 1980) which has a Rb-Sr whole-rock isochron age of 2,580 Ma

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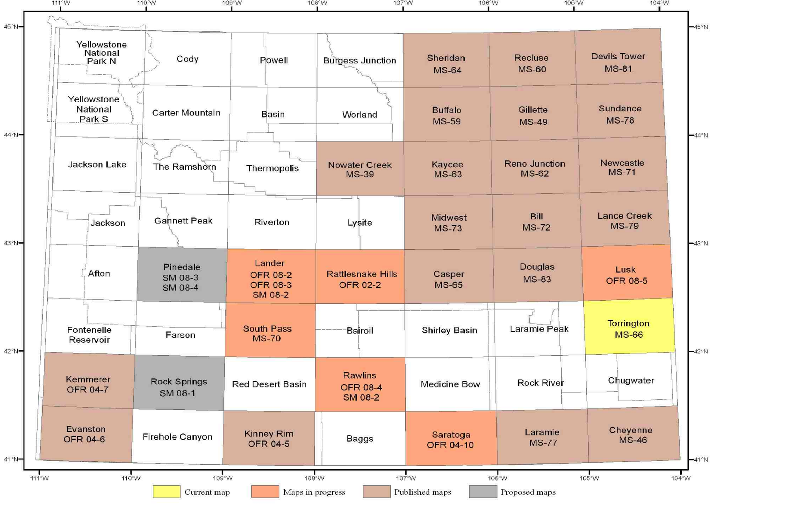

KEY TO ABBREVIATIONS
Wyoming State Geological Survey maps: Map Series (MS), Open File Report (OFR), Preliminary Geologic Map (PGM), and unpublished STATEMAP project (SMP).

INDEX TO 1:100,000-SCALE BEDROCK GEOLOGIC MAPS OF WYOMING